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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Lian-Ming Sun

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AIR LIQUIDE

Intellectual Property

2700 POST OAK BOULEVARD, SUITE 1800

HOUSTON, TX 77056

EXAMINER

STALDER, MELISSA A

ART UNIT

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1793

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/535,501	Applicant(s) SUN ET AL.	
	Examiner MELISSA STALDER	Art Unit 1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 27 and 29-45 is/are pending in the application.
 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 27 and 29-45 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. ____. |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date ____. | 6) <input type="checkbox"/> Other: ____. |

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 27 and 29-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nataraj (US 6,048,472) in view of Jinnouchi (GB 2123027 A). Nataraj '472 teaches a two-step method of producing synthesis gas where a hydrocarbon mixture is first pre-reformed and then reformed in a catalytic ceramic membrane after the first product is combined with an oxygen-containing gas. The synthesis gas produced comprises at least hydrogen, carbon containing compounds, water, and an oxygen-depleted mixture. The present claims disclose the heating of an oxidizing mixture to a temperature of about 1000 degrees C prior to reforming. Nataraj does not teach this temperature but broadly teaches heating an oxygen-containing oxidant gas and introducing the heated gas feed into a mixed conducting membrane reactor and teaches that the mixed conducting membranes may require temperatures substantially above 649 degrees C (columns 6 and 8). Jinnouchi teaches that the raw gases in a steam reforming reaction can be brought up to reaction temperatures which are between 750 and 1000 degrees C. Jinnouchi teaches bringing these "diluent gases" up to the temperature of the reaction. It would have been obvious to one of ordinary skill in the art at the time of the invention to have heated the oxidant gas in the method of Nataraj at a temperature such as 1000 degrees C because Jinnouchi teaches that gases for steam reforming can be

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heated to 1000 degrees C and that this process is energy efficient (pg. 2, line 46-pg. 3, line 7). Because Nataraj teaches that teaches that the mixed conducting membranes may require temperatures substantially above 649 degrees C, it would have been obvious to one of ordinary skill in the art that temperature at which the oxidant gas can be heated can be 1000 degrees C for feeding to the mixed conducting membrane reactor for reaction at temperatures substantially above 649 degrees C.

3. Regarding Claim 29, Nataraj teaches in column 12, line 54 that the heated oxidant is at a temperature preferably within 200° F (111°C) of the partially reformed gas.

4. Regarding Claim 30, Nataraj teaches (col. 11, line 3) that desulphurization of a hydrocarbon mixture prior to reformation is well known in the steam reformation art.

5. Regarding Claims 31 and 33, Nataraj teaches desulfurization of a reactant gas at 260° C to 427° C (col. 10, line 65) which overlaps with the instant range. *In re Malagari*, 182 USPQ 549 (1974), found that a claimed invention is prima facie obvious over prior art if the applicant's claimed range touches a preferred range and the applicant has not rebutted the prima facie finding with a showing of unexpected properties in the range or a teaching away of the claimed range.

6. Regarding Claim 32, Nataraj teaches (col.10, line 65) the hydrogenation of a reactant gas prior to the desulfurization step. Column 11, lines 2-5 states that a hydrogenation step is well known in the steam reforming art.

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7. Regarding Claims 34 and 36, Nataraj teaches (col. 11, line 32) that pre-reformation can occur in a catalytic reactor at a temperature between 372° C to 550° C.

This range completely encompasses the applicant's claim.

8. Regarding Claim 35, Nataraj teaches (col. 7, line 3) the use of an adiabatic reactor in a pre-reformation step.

9. Regarding Claims 37-38, Nataraj teaches in column 15, lines 37-67 that the oxygen-depleted nonpermeate is at a temperature at or slightly below that of the raw synthesis gas product. The temperature of the oxygen-depleted gas can be within 5° to 100° C of the synthesis gas. Nataraj also teaches (col. 14, line 50) that the reactant gas - the oxygen-containing gas—is preferably heated to the preferred temperature range of 816°, which is the same temperature as the raw synthesis gas when it is withdrawn from the outlet of the membrane reactor (col. 15, line 49). The claim states that the temperature difference is at least 75° C, which is encompassed in the disclosed range in Nataraj.

10. Regarding Claims 39 and 40, Nataraj teaches (col. 12, line 8) that the temperature range of the intermediate gas is 594° C to 760° C. *In re Malagari*, 182 USPQ 549 (1974), found that a claimed invention is prima facie obvious over prior art if the applicant's claimed range touches a preferred range and the applicant has not rebutted the prima facie finding with a showing of unexpected properties in the range or a teaching away of the claimed range.

11. Regarding Claim 42, Nataraj teaches (col. 16, line 59) that raw synthesis gas can be cooled and carbon dioxide can be removed from the synthesis gas.

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12. Regarding Claims 43 and 44, Nataraj teaches a purification or treatment of the synthesis gas (col. 17, lines 12-18).

13. Regarding Claim 45, Nataraj teaches (col. 18, lines 55-60) the use of treated oxygen containing gas and the use of this gas in direct combustion (col. 19, line 36). Nataraj discloses the use of air as an oxygenated gas. Air is typically 15-21% by volume O₂. It would be obvious to one of ordinary skill in the art to increase the percentage molarity of oxygen in the oxygenated gas mixture the reaction for the combustion of methane requires 2 moles of oxygen for every 1 mol of methane. Therefore, a greater volume of oxygen will make the reformation step more effective.

14. Claim 41 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nataraj in view Jinnouchi as applied to claim 27, further in view of of Prasad (US 6,695,984). Nataraj states in column 15, line 57 that the temperature of the oxygen-depleted non-permeate is either at or slightly below that of raw synthesis gas. However, Nataraj does not teach the claimed temperature range of 800° C to 1100° C. Prasad refers in line 8 of claim 12 to a synthesis gas stream at a temperature between 950° and 1100° C. *In re Malagari*, 182 USPQ 549 (1974), found that a claimed invention is prima facie obvious over prior art if the applicant's claimed range touches a preferred range and the applicant has not rebutted the prima facie finding with a showing of unexpected properties in the range or a teaching away of the claimed range. It would have been obvious to one of ordinary skill in the art of synthesis gas production to combine these references as Nataraj teaches that the preferred temperature range is greater than 816°

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C (col. 18, lines 7 and 16). Further, Prasad teaches (col. 6, line 51) that temperatures of 1000° C to 1100° C in a reactor facilitate a nearly complete conversion of methane.

15. Claims 27 and 29-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nataraj (US 6,048,472) in view of Steynberg (US 2004/0245086). Nataraj '472 teaches a two-step method of producing synthesis gas where a hydrocarbon mixture is first pre-reformed and then reformed in a catalytic ceramic membrane after the first product is combined with an oxygen-containing gas. The synthesis gas produced comprises at least hydrogen, carbon containing compounds, water, and an oxygen-depleted mixture. The present claims disclose the heating of an oxidizing mixture to a temperature around 1000 degrees C prior to reforming. Nataraj does not teach this temperature range but teaches heating to 871 degrees C. Steynberg teaches the heating of the synthesis gas to between 1000 and 1200 degrees C. It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Steynberg with the teachings of Nataraj because Steynberg teaches the use of the waste heat for electrical energy in the process (0012-0013).

16. Regarding Claim 29, Nataraj teaches in column 12, line 54 that the heated oxidant is at a temperature preferably within 200° F (111°C) of the partially reformed gas.

17. Regarding Claim 30, Nataraj teaches (col. 11, line 3) that desulphurization of a hydrocarbon mixture prior to reformation is well known in the steam reformation art.

18. Regarding Claims 31 and 33, Nataraj teaches desulfurization of a reactant gas at 260° C to 427° C (col. 10, line 65) which overlaps with the instant range. *In re Malagari*,

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182 USPQ 549 (1974), found that a claimed invention is prima facie obvious over prior art if the applicant's claimed range touches a preferred range and the applicant has not rebutted the prima facie finding with a showing of unexpected properties in the range or a teaching away of the claimed range.

19. Regarding Claim 32, Nataraj teaches (col.10, line 65) the hydrogenation of a reactant gas prior to the desulfurization step. Column 11, lines 2-5 states that a hydrogenation step is well known in the steam reforming art.

20. Regarding Claims 34 and 36, Nataraj teaches (col. 11, line 32) that pre-reformation can occur in a catalytic reactor at a temperature between 372° C to 550° C. This range completely encompasses the applicant's claim.

21. Regarding Claim 35, Nataraj teaches (col. 7, line 3) the use of an adiabatic reactor in a pre-reformation step.

22. Regarding Claims 37-38, Nataraj teaches in column 15, lines 37-67 that the oxygen-depleted nonpermeate is at a temperature at or slightly below that of the raw synthesis gas product. The temperature of the oxygen-depleted gas can be within 5° to 100° C of the synthesis gas. Nataraj also teaches (col. 14, line 50) that the reactant gas - the oxygen-containing gas—is preferably heated to the preferred temperature range of 816°, which is the same temperature as the raw synthesis gas when it is withdrawn from the outlet of the membrane reactor (col. 15, line 49). The claim states that the temperature difference is at least 75° C, which is encompassed in the disclosed range in Nataraj.

23. Regarding Claims 39 and 40, Nataraj teaches (col. 12, line 8) that the temperature range of the intermediate gas is 594° C to 760° C. *In re Malagari*, 182 USPQ 549 (1974), found that a claimed invention is prima facie obvious over prior art if the applicant's claimed range touches a preferred range and the applicant has not rebutted the prima facie finding with a showing of unexpected properties in the range or a teaching away of the claimed range.

24. Regarding Claim 42, Nataraj teaches (col. 16, line 59) that raw synthesis gas can be cooled and carbon dioxide can be removed from the synthesis gas.

25. Regarding Claims 43 and 44, Nataraj teaches a purification or treatment of the synthesis gas (col. 17, lines 12-18).

26. Regarding Claim 45, Nataraj teaches (col. 18, lines 55-60) the use of treated oxygen containing gas and the use of this gas in direct combustion (col. 19, line 36). Nataraj discloses the use of air as an oxygenated gas. Air is typically 15-21% by volume O₂. It would be obvious to one of ordinary skill in the art to increase the percentage molarity of oxygen in the oxygenated gas mixture the reaction for the combustion of methane requires 2 moles of oxygen for every 1 mol of methane. Therefore, a greater volume of oxygen will make the reformation step more effective.

27. Claim 41 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nataraj in view of Steynberg as applied to claim 27, further in view of Prasad (US 6,695,984). Nataraj states in column 15, line 57 that the temperature of the oxygen-depleted non-permeate is either at or slightly below that of raw synthesis gas. However, Nataraj does not teach the claimed temperature range of 800° C to 1100° C. Prasad refers in line 8 of

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claim 12 to a synthesis gas stream at a temperature between 950° and 1100° C. *In re Malagari*, 182 USPQ 549 (1974), found that a claimed invention is prima facie obvious over prior art if the applicant's claimed range touches a preferred range and the applicant has not rebutted the prima facie finding with a showing of unexpected properties in the range or a teaching away of the claimed range. It would have been obvious to one of ordinary skill in the art of synthesis gas production to combine these references as Nataraj teaches that the preferred temperature range is greater than 816° C (col. 18, lines 7 and 16). Further, Prasad teaches (col. 6, line 51) that temperatures of 1000° C to 1100° C in a reactor facilitate a nearly complete conversion of methane.

Response to Arguments

The prior art teaches bringing reactants up to reforming temperature, which overlaps with the claimed temperature. Because the prior art teaches that the reformation occurs at this temperature, one of ordinary skill in the art would know that the oxidant was at this temperature as well as this gas is part of the reaction. Applicant acknowledges that one skilled in the art could read the prior art in this way.

As discussed in the advisory action, the prior art of Nataraj discusses a preferable range but does not have a strict limit on the temperature. Further the claim 27 still uses the word "about." Therefore, the applicant does not have a strong argument that the reference of Jinnouchi would not be obvious to combine with Nataraj because these limitations on temperature do not have definite boundaries.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MELISSA STALDER whose telephone number is (571)270-5832. The examiner can normally be reached on Monday-Friday, 8:00-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Melvin Curtis Mayes can be reached on 571-272-1234. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MS

01-27-10

/Melvin Curtis Mayes/
Supervisory Patent Examiner, Art Unit 1793